17.5

SUPERFUND FINAL CLOSE OUT REPORT
Silver Mountain Mine NPL Site
Tonasket, Okanogan County, Washington

I. Introduction

This Final Close Out Report documents that the U.S. Environmental Protection Agency (EPA) has completed all remedial actions for the Silver Mountain Mine Superfund Site in accordance with *Close Out Procedures for National Priorities List Sites* (OSWER Directive 9320.2-09). The remedy has met the environmental, technical, legal, and institutional requirements specified in the Record of Decision and Explanation of Significant Differences. EPA and the Washington Department of Ecology (Ecology) conducted a final inspection on May 27,1997, and determined that the remedial action is functioning as designed and is protective of human health and the environment.

II. Summary of Site Conditions

Site Description and History

The Silver Mountain Mine Superfund site is located in Okanogan County, in north-central Washington State, about six air miles northwest from the town of Tonasket. The five-acre site lies in a north-south running valley known as Horse Springs Coulee. The area around the site is semi-arid with scrub vegetation and is primarily used for cattle grazing.

Underground, hard rock mining for silver and gold began at the site in 1902. By 1956, the sporadic development of the mine produced about 2000 feet of underground workings and several tailings piles in a mine dump consisting of waste and mineralized rock. A 400-ton per day mill was constructed in 1952, but was never used. The mill had been removed prior to the EPA's Superfund investigations.

From 1980 to 1981, Precious Metals Extraction, Ltd., constructed a cyanide heap leach pile and attempted to extract silver and gold from the previously mined tailings. The heap consisted of about 5,300 tons of mineralized rock in a 100 by 105 by 14 foot pile on top of a 20 mil plastic liner. About 4400 pounds of sodium cyanide was mixed with water and sprayed on the top of the heap. The cyanide-laden solution was then collected in a leachate pond at the base of the heap. In July 1981, the site was abandoned without cleanup or treatment of chemicals on the site. Cyanide solution remained in the leachate collection pond and in the heap pile. Several empty cyanide drums and large containers of carbon also were abandoned on-site.

1059840

Ecology investigated the site in November 1981, and took an emergency action to neutralize the cyanide solution with sodium hypochlorite in 1982. After applying the sodium hypochlorite twice and recirculating the solution through the heap and collection pond, the cyanide levels dropped from 1100 mg/l total cyanide to less than 1 mg/l total cyanide in the collection pond. Some residual cyanide, however, still remained in the heap material after applying the sodium hypochlorite solution and continued to leach as the concentration of cyanide was measured at 173 mg/kg in the heap pile in 1989. Some natural degradation of cyanide apparently did occur because there was no cyanide detected in the soil or heap pile by sampling done during site cleanup done in 1992.

Initial remedial planning activities were done by Ecology starting in 1981. The state provided immediate reduction of risks at the site by neutralizing the cyanide solution, and again in 1985 by removal of the drums of hazardous materials. Ecology recommended the site for the National Priorities List (NPL) in 1982. In October 1984, the site was added to the NPL by the EPA.

Studies Conducted at the Site

In 1988, EPA started the Remedial Investigation and Feasibility Study (RI/FS) by contracting with the U.S. Bureau of Mines (BOM). BOM conducted the site investigation which obtained the data necessary to determine the nature and extent of contamination. The physical and chemical characteristics of the site were evaluated by field mapping and analysis of site materials. The hydrogeologic investigation incorporated four monitoring wells, three off-site water supply wells, and two on-site surface seeps. EPA collected and analyzed thirty-four samples from the heap leach pile and mine dump material; twenty samples of nearby soils; and three rounds of water samples from the seven wells and the two surface water seeps.

The investigation identified and evaluated three potential sources of contaminants at the site:

- the heap leach pile,
- the unprocessed rock, and
- and mine drainage water.

Potential exposure pathways for contaminants were identified as :

- on-site soils,
- on-site surface water,
- on-site ground water in a shallow aquifer, and
- off-site ground water in the region.

The risk assessment identified arsenic and cyanide as the primary contaminants of concern. Arsenic is a component of the native rock in the area. The concentration of arsenic in the soil is related to the amount of arsenic in the native rock and whether it is oxidized. The oxidized arsenic is more soluble which in turn can increase the concentration in the soils from all of the mined materials, the heap pile, and the mine dump. The highest arsenic levels found during the RI/FS were in the mined material (1080 mg/kg) and in the water from the stock water tank (95 ug/l).

Cyanide was brought to the site and sprayed on the prepared heap of previously mined materials. Cyanide concentrations in the heap were reduced during the 1982 removal action taken by Ecology. The cyanide in the leachate pond was measured at a high of 1100 mg/l prior to the Ecology actions, and only about 1 mg/l was measured in the leachate after the Ecology removal. Soil samples prior to the Ecology removal ranged from 480 mg/kg total cyanide in the heap to 50 mg/kg just one foot away. During the RI/FS investigation in 1989, the cyanide concentration was measured as 173 mg/kg in the heap samples.

Both arsenic and cyanide were found in the perched shallow aquifer just at the edge of the heap pile. During the RI/FS, the concentrations were found to be elevated above the background (< 1.0 mg/l) in on-site monitoring wells. The monitoring wells showed arsenic concentrations 14 ug/l and cyanide concentrations of 122 ug/l. Both of these values are below the health-based standards for the site which are 50 ug/l arsenic (MCL) and 154 ug/l cyanide (Lifetime Health Advisory).

The Feasibility Study screened 23 various methods of cleaning up the site. From this list, eight alternatives were developed and evaluated against the nine Superfund criteria listed in the National Contingency Plan (NCP). Alternatives ranged from capping on-site to treatment and off-site disposal.

Record of Decision Findings

A Record of Decision (ROD), signed in March 1990, identified three primary contamination sources. Arsenic (approximately 1000 mg/kg) and cyanide (approximately 1100 mg/kg) were found in the heap leach pile of mined material and in the pond remaining from the abandoned cyanide heap leaching operation. The second source was a larger pile of unprocessed rock west of the heap pile from which the material was taken for the heap leaching operation. The rock also contained the same high levels of arsenic. The third source of contamination was the mine drainage water from the open mine entrance (adit, portal), also containing high levels of arsenic

(approximately 95 ug/l), was piped from within the adit to a cattle watering trough adjacent to the heap leach pond. Water from the trough overflowed and ponded on the site.

The ROD required implementation of the following cleanup actions:

- Consolidation of the arsenic and cyanide contaminated soil and mined rock. Cleanup standards were 200 mg/kg for arsenic and 95 mg/kg for cyanide.
- Construction of a soil/clay cap over the consolidated soil and rock.
- Closure of the mine entrance to divert mine drainage flow away from the site.
- Fence the site to protect the cap.
- Place deed restrictions on the property to protect the cap.
- Installation of a new well in the Horse Springs Coulee aquifer to provide an alternate stock water supply.
- Monitor ground water to ensure it does not become contaminated.

Following a review of the Potentially Responsible Party (PRP) search, the decision was made to implement the ROD as a fund-lead site.

On January 4, 1991, EPA and Ecology entered into a State Superfund Contract (SSC) to ensure that the State of Washington would provide matching funds for cleanup of the site. The construction estimate was $750,000 at that time. It was agreed in the SSC that EPA would implement the cleanup and pay 90 percent of the costs and that Ecology would pay the required 10 percent. Ecology also agreed to take over the operation and maintenance of the site once the vegetative cover was established. The SSC has been amended once to increase the total cleanup cost to $1 million with the state's share still remaining at 10 percent.

The March 1990 ROD was followed in October 1994 by an Explanation of Significant Differences to address conditions which were not predicted when the ROD was developed. This is discussed in greater detail below.

Remedial Construction Activities

EPA contracted with Roy F. Weston, Inc. (Weston), a prime contractor under the EPA ARCS program, to design and construct the remedy. The design was completed in late 1990, and a soil hauling subcontract was awarded on September 30, 1991. During December 1991, and January 1992, top soil for the cover over the cap was blended on-site and stockpiled. On April 3, 1992, Weston awarded the subcontract for the consolidation, capping and fencing of the site.

The construction work was completed during the summer of 1992:

- Mobilization and initial clay stockpiling (cap material) started June 29, 1992.
- Consolidation of mined material completed July 31, 1992.
- Closure of the mine entrance completed August 11, 1992.
- Cap and cover completed August 12, 1992.
- Site fenced August 15, 1992.

The consolidation action removed contaminated mine dumps from four areas around the site and collected them in a single location. The analytical results from the soils after the mine tailings were removed indicate that the soils were cleaned up to concentrations of arsenic less than 100 mg/kg and in some areas to less than 40 mg/kg. The site consolidation met the ROD performance goals of 200 mg/kg arsenic in exposed soils remaining at the site. The cyanide levels in all of the soil samples taken were all non-detectable (0.5 mg/kg detection limit).

Several background samples were taken from the soils sloughing off the hillside and onto the site. Two samples indicated arsenic concentrations over 400 mg/kg. It became clear during the site cleanup that some native soils had higher arsenic concentrations than the cleanup levels on-site. There is a distinct difference between the soil samples taken from the valley floor (less than 40 mg/kg arsenic). The site is located at the intersection of the valley floor where the heap leach pile was located and the mine portal which was excavated into the side of the mountain.

One of the past actions that occurred at the site was the construction of an aqueduct across the site along the edge of the valley. Rock rubble from the aqueduct construction was dumped over the edge of the cut and in several places commingled with the mine waste in the mine dumps. Where the two different activities commingled the rock, all the material was consolidated under the cap.

Following construction activities, surface water continued to enter the site at a slow rate from a new seep coming from the blocked mine entrance. This flow was diverted away from the capped landfill area towards an area off-site. Currently all surface water infiltrates into the ground before reaching the site fence.

Composite soil sampling was completed to verify the cleanup goals were met. "Action levels" initially used to indicate the need for further excavation were 33 mg/kg and 12 mg/kg for arsenic and cyanide, respectively. These action levels provided a margin of safety to ensure that the ROD cleanup goals were achieved via the excavation and considered the number of composite samples at each location in addition to contaminant background concentrations. The action level for arsenic was changed to 100 mg/kg from 33 mg/kg part way into construction because of difficulty in

achieving the action level due to natural background arsenic concentrations. The revised action level which is significantly below the ROD goal of 200 mg/kg and was established with Ecology's concurrence. Excavation and sampling continued in areas that exceeded the revised arsenic action limit of 100 mg/kg until all soil exceeding the limit was removed and consolidated on the heap leach pile.

The four monitoring wells that were placed during the RI/FS were not damaged during the construction, and were considered sufficient to provide long-term monitoring. Therefore, no new monitoring wells were constructed. The installation of the stock water supply well, as dictated by the ROD, was attempted in September 1992. The two test wells drilled did not locate water after drilling 320 feet and 72 feeting in the borings despite locations using the best available information. The resolution of this unforeseen development is further discussed in the next section.

Explanation of Significant Differences

In October 1994, EPA completed an Explanation of Significant Differences (ESD) to document changes in the remedial action due to unforseen conditions encountered at the site during implementation of the selected remedy. New information about the proximity of ground water to the site required EPA to modify the remedial actions that were described in the March 27, 1990, ROD. The changes were made with review and concurrence of Ecology. The two changes in site conditions are:

- to allow the stock water tank to be reestablished, if needed, using the mine drainage, as had historically occurred; and

- not to monitor the ground water.

The ROD stated that an alternate water supply would be provided to replace the mine drainage as a stock water source, assuming that the Horse Springs Coulee aquifer was a reasonable source in terms of quantity, quality, and depth of water. Two attempts in the vicinity of the site were made to locate a ground water source to replace the mine drainage as a water supply for live stock. Neither of the attempts were productive and water was not found despite drilling locations that were determined to be prime locations.

Since stock water is key to the usefulness of the land and water resources are very limited in the vicinity of the site, EPA's evaluation of other potential water sources necessarily focused on whether the mine drainage could still be used. The baseline risk assessment qualitatively noted an "enhanced" ecological risk from the stock tank as well as a human health risk (U.S. EPA, 1990). A subsequent assessment by EPA's contractor (Weston, 1994a) replaced standard default values associated with

consumption of stock water based on future industrial use. Use of site-specific exposure assumptions indicated that no significant ecological risk concerns arose from the presence of the stock tank. This allowed the mine drainage to be used as a source of stock water (e.g., by reestablishing the stock tank) and EPA was able to fulfill the intent of the ROD by leaving the property owner with a stock water supply.

After a review of the monitoring well depths and considering the lack of useable ground water near the site, it was determined that the site conditions do not warrant reestablishment of a ground water monitoring network for this site. This decision, made in consultation with Ecology, is based on the following:

- cleanup actions have diminished the threats to the ground water aquifer,
- the shallow ground water aquifer was not found above the bedrock formation at the site where water was previously thought to be located, and
- monitoring wells constructed during site studies were damaged beyond use.

These two changes were appropriately addressed in the ESD and not a ROD amendment because they are significant in terms of the scope of the construction work as specified in the ROD. The changes in the remedial action, however, did not change the risk factors or fundamental cleanup methods in the ROD.

Risk Reduction

EPA determined in the RI/FS that risks to human health and the environment would be reduced by the completion of the cap to cover the contaminated mine waste rock and closing the mine portal. EPA implemented the remedial actions which constituted these activities, and thereby reduced the health and environmental risks that were described in the RI/FS. EPA's remedial action met all of the applicable or relevant and appropriate requirements (ARARs), and controlled the increased risk from exposure to the contaminants of concern to less than one in ten thousand for arsenic and below the Hazard Index of 1.0 for cyanide.

Community Relations Activities

EPA published its Community Relations Plan in December 1987, after interviews with local residents and officials. An information repository was established at the Okanogan County Courthouse and all of the documents used to make the decision were placed there before the final Record of Decision was signed. All other reports and fact sheets were sent to the repository as they were completed. Those individuals on the mailing list were informed by fact sheet prior to construction activities on-site. No public meetings were requested.

III. Demonstration of Quality Assurance/Quality Control from Cleanup Activities

Quality assurance/quality control (QA/QC) procedures were utilized throughout the site investigation and cleanup actions at the site. EPA required that sampling and analytical work comply with EPA QA/QC procedures and protocols. Prior to any field work, a quality assurance project plan (QAPjP) and sampling analysis plan (SAP) were prepared and approved by EPA. The QAPjP stated the objectives for field events and the level of precision, accuracy, representativeness, comparability, and completeness required for data to meet the objectives.

On March 31, 1992, the QAPjP and SAP for the construction contract were approved by EPA. The plans called for a construction quality control manager to provide the quality assurance that all construction activities compiled with the approved plans. This required not only that the sampling be done according to EPA prescribed methods but also that the construction activities follow the approved design plans and specifications.

IV. Summary of Operation and Maintenance

The site remediation was designed to require very little maintenance. Deed restrictions are in place to limit actions that would disturb the cap and notify future owners of the hazard present (Steiner-Riley, 1997). The site is located in a remote area with semi-arid climatic conditions which suggest that only minimal maintenance is expected. The mined rock material under the cover is not expected to settle which is often the major cause of cap disturbance. The rainfall is low with an annual average precipitation of 11 inches/year which is primarily snow and spring rain. It is expected that, per the SSC, the Ecology personnel will be able to provide annual maintenance with a minimal amount of work. Routine annual maintenance of the cap will consist of activities such as weed control of woody vegetation and patching holes caused by burrowing animals, both of which could weaken the integrity of the cap.

On May 27, 1997, a final site inspection was conducted by representatives of both EPA and Ecology. The inspection verified that the constructed remedy is functioning as designed and has successfully resolved the threat from the site to human health and the environment.

V. Protectiveness

The remedial action cleanup activities at the Silver Mountain Mine site are

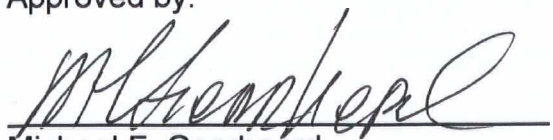
consistent with the objectives of the NCP and will provide protection to human health and the environment. The cleanup standards for the heap pile and mine dump materials and the surrounding soils are 200 mg/kg for arsenic and 95 mg/kg for total cyanide. According to the data obtained during the construction work, the cyanide in the soils is below detection (0.5 mg/kg), and the concentrations of arsenic that remain in the areas that were cleaned up are less than 100 mg/kg. Risks at the site have been reduced below the Hazard Index of 1.0 or health based levels; and for arsenic, a human carcinogen, the cancer risk factor has been reduced below one in ten thousand.

The major source of contaminants identified in the ROD, the rock material from the mining operations (heap and mine dump), has been addressed. The mine drainage was reevaluated in the Explanation of Significant Differences and it was determined that the mine drainage did not pose an ecological threat. According to the risk assessment and amended risk assessment, the inhalation and ingestion of the contaminated soils were the major routes of exposure. The arsenic-laden waste rock from the mine was contained and capped. The cleanup also reduced the impacts to the ground water by diverting the run-on water away from the capped mine waste and by limiting potential leachate generation.

VI. Five-Year Review

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requires a five-year review of all sites where hazardous substances are remaining above the health-based levels and there is unrestricted use of the site. Because the cleanup of the Silver Mountain Mine site utilized containment of the hazardous waste as the method to reduce the risk, a five-year review is required. The first five-year review was initiated in May 1997. The next five-year review is anticipated to occur in the year 2002. EPA will review Ecology's annual report on the operation and maintenance at the site and perform future five-year reviews. The review will determine if the cleanup standards continue to be met and are protective of human health and the environment, and that the remedy is functioning as designed.

Approved by:



6-19-97

Michael F. Gearheard
Associate Director
Environmental Cleanup Office

Date

VII. Bibliography

U.S. Environmental Protection Agency. 1995.
Close Out Procedures for National Priorities List Sites. Office of Emergency and Remedial Response. EPA/540/R-95/062. OSWER Directive 9320.2-09. August 1995.

U.S. Environmental Protection Agency, Region 10. 1990.
Record of Decision for the Silver Mountain Mine Superfund Site. Seattle, Washington. March 1990.

U.S. Environmental Protection Agency, Region 10. 1992.
Preliminary Close Out Report for the Silver Mountain Mine. September 28, 1992.

U.S. Environmental Protection Agency, Region 10. 1994.
Explanation of Significant Differences: Silver Mountain Mine. October 12, 1994.

Weston, Roy F., Inc. 1993.
Remedial Action Report: Silver Mountain Mine. Prepared for U.S. Environmental Protection Agency. Contract No. 68-W900046, Work Assignment No. 46-01-0L91, Document Control No. 4000-04-71-AAAD. September 17, 1993.

Weston, Roy F., Inc. 1994.
Technical memorandum: Risk Assessment Addendum for Stock Tank - Silver Mountain Mine Site, Tonasket, Washington. Prepared for U.S. Environmental Protection Agency. September 1994.

Weston, Roy F., Inc. 1994.
Silver Mountain Mine: Maintenance Plan. Prepared for U.S. Environmental Protection Agency. December 1994.

Superfund Site Final Close Out Report for Silver Mountain Mine, Tonasket, Okanogan County, Washington

Concurrence				
Initial	ADD	CSR	Ok	
Name	Dailey	Steiner-Riley	Krueger	
Date	6/17/97	6/17/97	6/18/97	